PROJECT FEATURES DESCRIPTION AND PERMIT APPLICATION SKETCHES

The Cobbs Creek Reservoir Project (Project) is being proposed by a regional partnership of communities along the James River consisting of Cumberland County, Henrico County and Powhatan County. Goochland County likewise has a vested interest in this project since its future water needs will be met by Henrico County under the current water agreement between those two counties. To this end, the regional partners have formalized discussions under which planning, construction and operation of this Project will be carried out. Cumberland County's Board of Supervisors has endorsed the Cobbs Creek Reservoir Project and the political leadership of partners Henrico County and Powhatan County have likewise fully endorsed this permit application.

In response to the drought of 2002, the Virginia General Assembly in concert with the Governor passed legislation which directs the Virginia Department of Environmental Quality (VDEQ) to develop regulations to direct the development of water supply plans for every locality in Virginia. The regulations will require plans designed to ensure that adequate and safe drinking water is available to all citizens of the Commonwealth, and encourage, promote, and protect all other beneficial uses of the Commonwealth's water resources. The Cobbs Creek Reservoir Project is consistent with these objectives and is a model for regional cooperation to serve a greater need as opposed to serving only a single community.

The proposed regional off-stream reservoir near the James River in northern Cumberland County will be a multi-purpose reservoir designed to provide the following primary benefits:

- A reliable future water supply for Cumberland, Henrico, Goochland and Powhatan counties.
- Reduced stress upon the James River during critical drought conditions.
- Low flow augmentation of James River flows to benefit instream uses such as fisheries, recreation and water quality.
- A recreation amenity to Cumberland County citizens and others who will visit the reservoir.

The Cobbs Creek Reservoir Project would be a pumped storage facility providing 14.8 billion gallons of raw water storage within a 1,107-acre normal pool area. Raw water safe yield of this project is estimated to be 53 million gallons per day (mgd). Key project components would include a dam and reservoir, James River withdrawal facilities on the County's northern border, reservoir withdrawal facilities, and transmission main(s). Raw water would be diverted to the reservoir from the James River when river flows are adequate. Reservoir withdrawals and/or controlled releases from reservoir storage would be made during drought and other periods when James River flows are inadequate to support regional demands. This capability to augment flows in the middle James River Basin is a key aspect to this project. Currently, there is no comprehensive management plan and only limited capability to augment flows between Gathright Dam at Lake Moomaw and the Richmond metropolitan area water intakes, a distance of over 270 river miles.

During low flow periods, the return of stored water to the James River will provide for a number of beneficial uses. There will be improved instream flow in the substantial river reach between Cumberland's discharge location and Henrico County's intake; this will support or enhance habitat, fisheries and water quality here. There will be improved conditions downstream. Both Richmond and Henrico currently hold Water Protection Permits that include river flow values which, under certain circumstances, trigger conservation measures by those systems. Analysis of flow augmentation capabilities of the Cobbs Creek Reservoir Project show that many historic instances of tripping a trigger flow could have been avoided with the proposed reservoir in operation. Additionally, the proposed reservoir can ensure water volumes are present in the river for use by downstream public water systems during low flow periods. Flow augmentation will also benefit recreational uses in the river such as swimming, fishing and canoeing.

A Project Location Map (Sketch 1) and a Project Vicinity Map (Sketch 2) can be found at the end of this section. The Project Vicinity Map indicates all of the major components of the project.

The remainder of this section describes the individual components which make up the Project. The individual components of the Project are grouped together based on their primary functions, as follows:

- River Withdrawal
- Reservoir Storage
- Reservoir Release

Design and analysis of the various components has been carried out to the conceptual level. Changes to the conceptual designs of these components may occur as the results of additional site investigations become available and performance criteria for the Project are finalized.

1 JAMES RIVER WITHDRAWAL SYSTEM

1.1 Site Selection

Several potential river withdrawal siting zones were identified along the southern shore of the James River in Cumberland County. These sites were identified through review of Virginia Geographic Information Network (VGIN) aerial photography, VGIN topographic mapping, and United States Geologic Survey (USGS) topographic mapping. Specific sites within the potential zones were defined based on a field reconnaissance, including a potential site approximately 2,000 feet upstream of the mouth of Cobbs Creek.

Additional field reconnaissance of this site and the adjacent areas immediately upstream and downstream of the mouth of Cobbs Creek was undertaken based on the selection of Cobbs Creek as the preferred reservoir alternative. This reconnaissance identified the best intake site as being just downstream of the mouth of Cobbs Creek. The overall river withdrawal system at this site, including the intake, pump station, pipelines, and several other features, are shown on Sketch 3.

The river withdrawal site is on the southern shore of the river, in an area with a natural river depth that is slightly deeper than adjacent upstream and downstream areas, based on soundings performed during the field reconnaissance. The site is immediately upstream of a riffle complex and is on the outside of a slight bend in the river. The bottom was observed to be hard, rocky, with less sands and silts in the center portion of the river than in the other prospective locations and a narrow band of silty material along the southern bank. The southern bank of the river consists of an approximately 200-foot wide floodplain and a steep rise up to Elevation 240 (North American Vertical Datum (NAVD)), which is well above the 100-year flood level of the River at this location. This bank condition exists along approximately 1,500 feet of shoreline.

The river withdrawal site is currently accessible by means of an existing logging trail that runs down a ridge line from Route 690 to within approximately 800 feet of the river shoreline. An access road could be created along this ridge line. The river withdrawal site is located approximately 3,000 feet from the main dam site. A Dominion Virginia Power high voltage power line is located approximately 2,000 feet from the river withdrawal site.

The topography of the site will allow for a pump station structure to be located out of sight of all existing inhabited dwellings and the river. The pump station structure will be constructed on uplands and will have no permanent impacts to wetlands. Any temporary wetland impacts would be a result of the buried pipe installation work.

1.2 Intake System Selection

An intake system capable of withdrawing an average of 53 million gallons per day and an instantaneous maximum of 150 million gallons per day from the James River is proposed. These rates are equivalent to 82 cubic feet per second (cfs) and 232 cfs, respectively. The intake system should be capable of operating over a wide range of river flows, down to as little as 1,250 cfs. While the maximum capacity of the withdrawal system is unlikely to be utilized when the river is flowing at this minimum rate, the ability to pump approximately 50 mgd to the reservoir when the river flow is 1,250 cfs could be crucial to maximizing the yield and overall benefit of the Project. Based upon a detailed topographic survey of the river at the intake site, the average water depth in the river at a flow of 1,250 cfs (the estimated minimum flow at which withdrawals would be allowed) will be approximately 3 feet.

The intake must also be able to operate reliably under high flow conditions and be able to tolerate the large flood events that occasionally occur on the James River. These flood water depths rise up to 30 feet or more above the normal range of river depths in the area of the intake and can carry heavy sediment and debris loads.

Several styles of intake systems were evaluated for their ability to meet the project performance criteria noted in the previous paragraph, while minimizing impacts to the environment and recreational use of the river. Recreational use of this section of the river includes power boating, canoeing and kayaking, tubing, and fishing. An intake style that minimizes impacts and potential hazards to recreational users of the river is preferred. With the completion of the Bosher Dam Fishway in 1999, this section of the James River is now open to American shad, hickory shad, alewife, blueback herring, striped bass, and other anadromous fish species. An intake style that minimizes the impingement and entrainment of fish eggs and larvae is preferred. The following list summarizes the systems considered and notes the key limiting factors identified for each (the systems are listed in order from worst to best):

- *Off-Stream Canal Intake:*

An off-stream canal intake system would consist of cylindrical wedge-wire screens mounted in a man-made, off-stream, flow-through intake canal. This style of intake system has been considered on other projects in Virginia in an attempt to create an intake that is out-of-site of the main river.

The concept is to excavate a canal through the flood plain area adjacent to the natural river channel, install screens in the canal, and extend the canal past the screens to allow for the flow of water (and fish) past the screens and back to the river. In order to withdraw 150 mgd, 26 tee screen assemblies, each 42 inches in diameter and approximately 15 feet long, would be required if they were constructed with 1-mm slot openings and limited to an average through slot velocity of 0.25 fps.

These screens would require at least 7 feet of water depth to operate properly, which would require the off-channel canal to be excavated to a depth below that of the adjacent river. The overall length of an intake structure with a double row of intake screens mounted on vertical riser pipes would be 225 to 250 feet and its width would be approximately 25 feet. To manage the sediment and debris which would collect in this deepened screen area under normal conditions, the bottom and side walls would be a smooth concrete surface and a water jet system would need to be provided to agitate any settled sediment, allowing it theoretically to be carried away by the current flowing through the channel.

An intake canal would likely intercept the heavier debris and silt load that is typically found along the shoreline of a river such as the James, and direct it to the screens. The concept is that the flow of water past the screens and back to the river would carry this material back to the river. However, it is likely to be very difficult to construct a canal that will have any significant flow beyond the screens due to the adjacent river conditions. Water will flow preferentially down the path of least resistance, which, in this case, would be the main river channel. Unless the main channel is partially blocked, such as by a low level dam, there will be no way to force water to flow past the screens. Creating a low level dam across the James River in order to force flow into an off-stream canal is considered neither practical nor permittable.

Flood flows in the James would tend to deposit large sediment loads in the canal, as they do in most natural streams that cross the flood plain. It would be difficult and costly to remove this sediment and would likely prevent the intake from operating for a period of time following major flood events. With little to no flow past the screens, the intake canal would effectively become a dead-end, trapping fish eggs and larvae in the screen area and increasing the potential for their impingement and entrainment. For these reasons, the off-stream canal style of intake is not recommended for further consideration.

- *Shoreline Intake Structure with Flat Panel Screens:*

A shoreline intake structure with flat panel screens would consist of multiple flat-panel, wedgewire screens mounted on the face of an intake structure located on the southern bank of the river. In order to withdraw 150 mgd with intake screens 4 feet tall, the intake would have to be 580 feet long, if it were constructed with 1-mm mesh openings and the average through slot velocity were limited to 0.25 fps (screen criteria recommended by the Virginia Marine Resources Commission for the intake proposed by Fluvanna County at Bremo Bluff).

A 4-foot tall screen could be mounted on a bulkhead at the shoreline if the silts and sands on the river bottom were dredged from the area directly in front of the bulkhead. However, siltation of the dredged area would likely occur with each storm event. The overall length of the intake structure and riprap along the bank of the river would be between 600 and 700 feet. The trees on the top of and behind the riverbank would be cleared for construction of the intake, and the area would need to be kept cleared to allow for maintenance access to the screens along the entire length of the structure.

Flat panel screens are relatively difficult to clean and subject to uneven flow patterns. Screens mounted along a river bank are generally more likely to intercept debris and silt than screens in the deeper center section of a channel. The intake structure would be partially to totally visible, depending on river level, to recreational users of the river. For these reasons the flat panel screen style of intake is not recommended for further consideration.

- *Shoreline Intake Structure with Cylindrical Wedge-Wire Screens:*

A shoreline intake structure with cylindrical wedge-wire screens would consist of multiple cylindrical wedge-wire screens mounted on the face of an intake structure located on the southern bank of the river. In order to withdraw 150 mgd, 26 tee screen assemblies, each 42 inches in diameter and approximately 15 feet long, would be required if they were constructed with 1-mm slot openings and limited to an average through slot velocity of 0.25 fps. These screens would require at least 7 feet of water depth to operate properly, which would require the river bed to be excavated to create a trench area below the screens.

The overall length of an intake structure with a single row of these screens mounted bulkhead style on the front face would be approximately 450 feet. If the screens were arranged in two rows, one row bulkhead mounted and the second row on vertical riser pipes, the structure length could be reduced to 225 to 250 feet, while increasing the encroachment into the river. Smaller screens could be utilized that would reduce the depth of trench required to accommodate the screens, but more screens would be required and the overall length of the intake structure along the river bank would increase proportionally. The trees on the top of and behind the riverbank would be cleared for construction of the intake, and the area would need to be kept cleared to allow for maintenance access to the screens along the entire length of the structure.

Cylindrical screens mounted near the shoreline would intercept debris and silt load similarly to bulkhead mounted flat panel screens. For these reasons the bank mounted cylindrical wedge-wire screen style of intake is not recommended for further consideration.

➢ *Central River Trench with Cylindrical Wedge-Wire Screens:*

A central river trench with cylindrical wedge-wire screens would consist of multiple cylindrical wedge-wire screens mounted in a submerged trench located in the main channel of the river. In order to withdraw 150 mgd, 26 tee screen assemblies, each 42 inches in diameter and approximately 15 feet long, would be required if they were constructed with 1-mm slot openings and limited to an average through slot velocity of 0.25 fps. These screens would require at least 7 feet of water depth to operate properly. This would require the river bed to be excavated to create a trench area below the screens. To minimize the potential for the collection of sediment and debris in this recessed area, the bottom and side walls would be finished with a smooth concrete surface. The sides would extend slightly above the adjacent natural bottom of the river, and a water jet system would be provided to agitate settled sediment allowing it to be carried away by the current flowing through the channel.

The overall length of an intake structure of this type with a double row of intake screens mounted on vertical riser pipes would be 225 to 250 feet with a width of approximately 25 feet. Smaller screens could be utilized to reduce the depth of the trench, but more screens would be required. Even with smaller diameter screens a trench would still be required, and the overall footprint of the intake structure in the river would increase proportionally. Trees along the river bank would need to be cleared to create access ramps for the construction of a temporary cofferdam and for access into the work area within a cofferdam. After construction of the intake was completed, these areas could be restored and trees allowed to grow again. One area would need to be maintained available for the launching of boats for occasional screen inspections and maintenance.

Cylindrical screens mounted in the main channel of the river would intercept less debris and be subject to less silt load than screens near the shoreline.

Screens in the center of the river would be submerged during periods of normal flow and would not directly affect boating on the river. However, fishing, wading and tubing would be affected under normal and low flow conditions. The screens and deeper trench area around them could present a hazard to people tubing or wading in the river, due to the sudden drop off into the trench, and the screens could pose a snag hazard. During very low flow periods the top of the screens would become visible and could become exposed. For these reasons, cylindrical wedge-wire screens mounted in a deepened trench, away from the riverbank, is not recommended for further consideration.

➢ *Infiltration Bed with Buried Horizontal Well Screens:*

An infiltration bed with horizontal well screens would consist of multiple lengths of small diameter well screens buried in a constructed infiltration bed below the existing bottom of the river. In order to withdraw 150 mgd, an infiltration bed area of approximately 60,000 square feet (75 feet wide by 800 feet long) has been assumed in order to provide extremely low approach velocities that would help limit the withdrawal induced entrainment of fine silts and debris on the surface of the bed. The infiltration bed would be constructed by excavating the existing river bottom to a depth of approximately 7 feet below the existing river bottom, placing horizontal wells screens in the excavated area, backfilling over the screens with a gravel filter pack and covering the gravel with courser stone and riprap. The top layer of riprap would be placed and graded so that the bottom of the restored riverbed would match the pre-existing river bottom conditions. River water would filter through the riprap, stone, and gravel layers to the well screens. The multiple screens would connect to larger solid pipes that would run under the river bank to the pump station. Trees along the river bank would need to be cleared to create access ramps for the construction of a temporary cofferdam and for access into the work area within a cofferdam. After construction of the intake was completed, these areas could be restored and trees allowed to grow again.

This system would not extend above the existing river bed. It would be practically invisible to recreational users of the river. It would not create any permanent hazard to recreational boating, tubing, wading, or fishing in the river. The only impacts to recreational users would be temporary during construction. A temporary coffer dam would need to be constructed across approximately half of the river during construction. For these reasons, an infiltration bed intake system is recommended as the preferred intake style for the James River Withdrawal System.

1.3 Infiltration Bed Intake System

The infiltration bed intake system will be constructed in the bed of the James River. Sketch 4 shows the location and a conceptual layout of the infiltration beds. The intake system will consist of a series of horizontal well screens buried in a gravel filter pack layer. The fine gravel filter pack will be protected from the erosive flow of the river by an intermediate layer of larger gravel and a surface layer of riprap. The well screens will have 1 mm slot openings. The infiltration beds will be constructed to form up to six separate sections. For six sections, the capacity of each would be 25 mgd. Each infiltration bed will have a separate intake header pipe that extends onto the James River shoreline where an isolation valve will be located. These intake header pipes will then combine into larger intake lines that will extend the remainder of the distance to the pump station wet well. A typical section of the infiltration beds is shown on Sketch 5. To allow for phasing of the construction of the infiltration beds, each pair of beds will be separated from the adjacent pairs by an undisturbed section of the river bed. This will allow for intermediate cofferdam segments to be constructed between the pairs of beds and should reduce the amount of dewatering required within each cofferdam cell.

As an added protection against clogging of the gravel pack, the infiltration bed intake system and James River Pump Station will include provisions for a water backwash of each infiltration bed section. This type of backwash is typically performed at a flow that is approximately double the intake rate of the infiltration bed. For example, the backwash rate would be 50 mgd for a 25-mgd infiltration bed section. This rate has been reported to be effective in flushing fine material out of the gravel filter pack while limiting the disturbance and displacement of the gravel pack.

A total of approximately 900 feet of 12-inch well screen would be required in a 25 mgd bed. A 25-mgd bed would cover approximately a 75- by 133-foot area on the river bottom. The well screen piping would be arranged in equal length branch lines extending from a central intake header. The intake header will run to the southern shore of the river.

The infiltration bed system will be located in a naturally scoured section of the James River. The existing water depth at the screen location averages approximately 5 feet. The river bottom will be restored with riprap to match the pre-existing bottom contours. To the maximum extent possible, native stone removed during the construction will be re-used for the top riprap layer in order to match the natural color of the adjacent undisturbed river bottom.

Dredging and work within a cofferdam will be required to construct the buried infiltration bed intake system in the bed of the James River. The total estimated volume of material to be excavated from the river bed is 15,000 cubic yards.

During construction, at least half of the main river channel will be maintained open and unobstructed, between the cofferdam work area and the north shore of the main river channel, so that recreational use of the river will not be impeded. The natural channel on the north side of Cobbs Island, across the river from the intake site, will remain open throughout the construction period. All temporary work and permanent facilities will be located entirely within the limits of Cumberland County.

The individual header lines from each infiltration bed will extend onto the southern shore of the river then combine into several larger intake lines. If six infiltration beds are constructed, then three parallel intake lines would be utilized. Each individual header line will contain an isolation valve at its connection to the intake line, to allow for each bed to be isolated for maintenance and allow for occasional backflushing of the beds. The individual header lines will be routed to come ashore in pairs in order to minimize shoreline disturbance. Portions of the shoreline adjacent to the infiltration bed intake system will remain undisturbed during and after construction.

The intake lines will run across and along the flood plain area on the southern shore to the James River Pump Station. Where possible, a 50-foot wide band of trees will remain undisturbed between the onshore intake lines and the riverbank, to provide a visual screen. The area over the intake lines will be maintained in a pasture like state, with grass cover that is mowed occasionally to allow for inspection of the area. A gravel access road will be constructed along the intake lines, to provide access to the isolation valves on the individual header lines. The river bank will be restored and trees allowed to grow along the top of bank in most of the areas disturbed by construction. Several observation areas along the top of the river bank will be kept cleared to allow for visual inspection of the infiltration bed area.

Only granular and stone materials will be used for backfill of the infiltration beds. Excavated material that is suitable for backfill will be reused for riprap cover over the filter pack. This reuse of native material would assure the completed beds are as aesthetically similar to the existing river bottom as possible. Excess excavated material will be utilized within the Project, for access road construction, as general fill, or other similar uses. The infiltration beds will extend into the river a total of approximately 100 feet from the south shore mean high water line.

The top of the well screens will be set an average of 5 feet below the existing bottom of the river. The entire area temporarily filled for construction of the coffer dam and excavated for construction of the infiltration beds will be restored to match the existing bottom elevation of the river. The complete infiltration bed system will be buried. No piping or structure will extend above the restored river bottom and river bank, or be visible from the river. Recreational use of the river will not be permanently impacted by the permanent intake system in any way.

A manually controlled water backflush cleaning capability will be provided for the infiltration bed intake system. This capability will allow debris that has settled out of the water column and into the gravel filter pack and riprap cover to be flushed out of the bed and back into the water column, allowing it to be carried away by the natural river current.

The infiltration bed sections will typically be cleaned sequentially, starting with the most upstream section and proceeding downstream. With this approach, debris flushed from the first bed, which might settle on the adjacent downstream sections, will be removed from the adjacent downstream sections once they are cleaned. After all of the beds have been backflushed, the debris that had settled in the beds will have been returned to the flowing water of the river, which is where it would have come from originally.

Backflushing is expected to be required on a very infrequent basis only. There are very few installations with design criteria and approach velocities as low as those proposed for this installation. Silt and debris loads in a river water column are site specific and will also vary seasonally and in response to specific storm events. As a result, it is difficult to predict the frequency of backflushing that will be required. To provide for maximum flexibility in backflushing operations, the piping and valves at the pump station could be configured to allow backflushing to be performed either with water from the reservoir or with water pumped from the other infiltration bed sections.

1.4 James River Pump Station

The James River Pump Station will be located south of the southern bank of the river and east of Cobbs Creek, as shown on Sketch 3. It will be located on sloping ground between approximate ground surface elevations of 210 and 230 feet (NAVD 88). This will allow the operating floor to be set above the 100-year flood level (NAVD 88 Elevation 218 feet at this location). The pump station will be approximately 4,100 feet (0.75 miles) from the nearest house, which is located on the opposite side of the James River. The nearest house on the Cumberland County side of the James River is approximately 4,500 feet (0.85 miles) from the pump station. It is located on the opposite side of Columbia Road (Route 690).

The James River Pump Station will have a wetwell extending to an elevation lower than the bottom elevation of the river. To provide 150 mgd of firm pumping capacity, multiple pumps will be installed. Variable pumping rates will be achieved by adjusting the number of operating pumps. The elevation of the pump room floor will be set above the James River's 100 year flood elevation, 218 feet (NAVD 88). Pumps will be operated in order to maintain the desired water level in the Cobbs Creek Reservoir, to the extent allowed by the James River Minimum Instream Flow (MIF) conditions and any other withdrawal limitations.

The pump station and other associated structures will be designed in an architectural style similar to other structures typical to this section of the river. The pumps will be located inside the station which will be designed to minimize exterior noise levels due to pump and equipment operation.

The pump station site is located on Cumberland County Tax Map No. 2, Parcel 1. An area of approximately 25 acres would be required for the pump station. A low impact development (LID) layout is planned at the pump station site, with the pump station access road and parking area located above the 500-year flood plain.

1.5 James River Flow Measurement

Flow monitoring of the James River currently occurs at several USGS gaging stations along the length of the river. The Scottsville gage is the closest gage upstream of the intake. The Cartersville gage is the closest gage downstream of the infiltration bed intake system. Flow at the intake can be estimated based on the measured flow at Cartersville or Scottsville with an appropriate adjustment for the difference in drainage area of the James River at the intake.

An automatic data download system using phone lines or radio telemetry for communication could be used to collect the gage data on a daily basis or this could be accomplished manually. The Cartersville and Scottsville gage data is also currently available on a near real-time basis on a USGS website. The corresponding maximum allowable withdrawal rate would be calculated on a daily or weekly basis, in accordance with the MIF policy contained in the Virginia Water Protection permit.

Measurement of pumped flows will be provided by one or more flowmeters in the discharge piping on the pump station site, and recorded daily. Pumpage will be reported monthly to the Virginia Department of Environmental Quality.

1.6 Administration/Maintenance Building

An administration/maintenance building will house an office, a meeting/multipurpose room, a kitchen, restrooms with locker/changing areas, and a maintenance garage area. This building will be located on an upland site.

1.7 Cobbs Creek Transfer Pipeline

An 84-inch diameter, 3,000-foot long buried supply/release pipeline will exit the pump station and run along the east side of Cobbs Creek to the Cobbs Creek Dam as shown on Sketch 3. The pipe will extend through the base of the dam to the reservoir inlet/outlet structure. The pipeline will be used to convey water both from the pump station to the reservoir and from the reservoir back to the pump station or to an outfall located below the dam on Cobbs Creek. Flow from the reservoir to the pump station will be used for infiltration bed backflushing as well as river augmentation releases. Flow to the outfall will pass through an energy dissipating structure prior to being discharged to Cobbs Creek. These structures are further described in Section 3, Reservoir Release Facilities.

2 COBBS CREEK WATER STORAGE FACILITY

2.1 Topographic Mapping

The vertical datum for the USGS quadrangle mapping of the project area is the National Geodetic Vertical Datum of 1929 (NGVD 29). The vertical datum of the bathymetric/topographic survey of the James River intake site that was recently conducted is the North American Vertical Datum of 1988 (NAVD 88). The NAVD 88 datum is currently the standard datum utilized in most of the United States. In the area of the Cobbs Creek watershed these datums differ by 0.9 feet. The NGVD 29 datum is "lower" than the NAVD 88 datum. This means that an NGVD 29 Elevation of 345.9 is equivalent to an NAVD 88 Elevation of 345.0.

For consistency, the descriptions of the River Withdrawal Facilities, Water Storage Facilities, and Reservoir Release Facilities are all referenced to the NAVD 88 vertical datum. All future survey work for the Project will also be referenced to the NAVD 88 vertical datum.

2.2 Preliminary Geotechnical Foundation Assessment

Overall Project and dam site development feasibility are most directly related to the nature, engineering characteristics and thickness of overburden soils and the nature, geologic structure and engineering characteristics of the bedrock at the proposed dam site and adjacent potential borrow areas.

Based on the information currently available, the dam site appears suitable for construction of an earth fill dam. The site also has the potential to be suitable for construction of a roller compacted concrete dam. The depth to rock, competency and strength of the rock, and depth and characteristics of the decomposed rock and surficial soils at the dam site and potential borrow sites must all be determined from on-site investigations in order to more fully assess the suitability of the site for either an earthfill or a roller compacted concrete dam.

2.3 Cobbs Creek Dam

The Cobbs Creek Dam will be located approximately 3,000 feet south (upstream) of the confluence of Cobbs Creek with the James River. It will be constructed to impound water up to a normal pool elevation of 345 (NAVD 88) and allow for a maximum flood pool elevation of 347 (NAVD 88). The dam will be designed as either an earth fill embankment or roller compacted concrete structure. As noted in the previous section, the final selection of dam type will depend on the findings of a detailed geotechnical field investigation of the dam area and potential borrow areas. The dam should be constructed to the greatest degree possible with on-site materials. Layouts of the earth fill embankment style dam and the roller compacted concrete style dam are shown on Sketch 6 and Sketch 7, respectively. Typical sections of both of these dam styles are shown on Sketch 8.

If an earthfill embankment dam is selected as the most appropriate dam type, upstream and downstream sideslopes of 3:1 (horizontal to vertical) or steeper are expected to be feasible. From the existing valley bottom at Elevation 200 feet (NAVD 88) to an estimated top elevation of 352 feet (NAVD 88), the dam embankment will be approximately 152 feet tall. The foundation of the dam will need to extend down to reach firm foundation materials. However, until soil borings are performed along the dam alignment the required depth below existing grade and the need for foundation treatment and seepage cutoff is unknown. With a top width of 20 feet and two 10-foot access/runoff control benches on the downstream dam face, the maximum base width of an earthfill dam is estimated to be approximately 1,000 feet.

If roller compacted concrete is selected as the most appropriate dam type, then a nearly vertical upstream slope and a 0.75:1 (horizontal to vertical) downstream slope is expected to be feasible. An RCC dam will be the same height as an earth fill embankment dam, approximately 152 feet tall. The dam foundation will need to extend down to reach firm foundation materials. The required depth below existing grade and the need for foundation treatment and seepage cutoff will not be known until soil borings are performed along the dam alignment. With a top width of 20 feet, the maximum base width of a roller compacted concrete dam is estimated to be approximately 150 feet.

Based on USGS Quadrangle topographic mapping and a preliminary dam alignment, the dam crest length for either type of dam would be approximately 3,800 feet at an elevation of 352 feet (NAVD 88).

The upstream face of an earth fill dam would be protected from wave erosion by a riprap blanket which would extend down the face to approximately elevation 290 feet (NAVD 88). This would extend 10 feet below the expected minimum working pool elevation of 300 feet. The downstream face of an earth fill dam would be grass covered. The downstream toe of both dam types would need to be designed to withstand submergence, essentially a tailwater, due to James River flooding. Under 100 year flood conditions, the maximum floodwater elevation at the toe of the dam would be approximately 20 feet (elevation 218, NAVD 88).

2.4 West Saddle Dam

The West Saddle Dam is required at an existing topographic depression, or saddle area, located approximately 2,000 feet west of the west end of the proposed Cobbs Creek Dam and 3,000 feet south of the James River. The natural ground surface at this location drops from approximately Elevation 360 (NAVD 88) to approximately Elevation 330 (NAVD 88). The saddle dam could be constructed as an earth fill embankment dam or a roller compacted concrete dam, as shown on Sketch 6 and Sketch 7, respectively.

With a top width of 20 feet, the maximum base width of an earth fill dam at existing ground level would be approximately 175 feet. The maximum base width at existing ground level of a roller compacted concrete dam with a top width of 20 feet would be approximately 50 feet.

Based on USGS Quadrangle topographic mapping, the total saddle dam crest length will be approximately 1,000 feet at an elevation of 352 feet (NAVD 88) for either type of construction. The upstream dam face of an earth fill dam would be protected from wave erosion by a riprap blanket which would extend down the entire dam face. The downstream face of an earth fill dam would be grass covered.

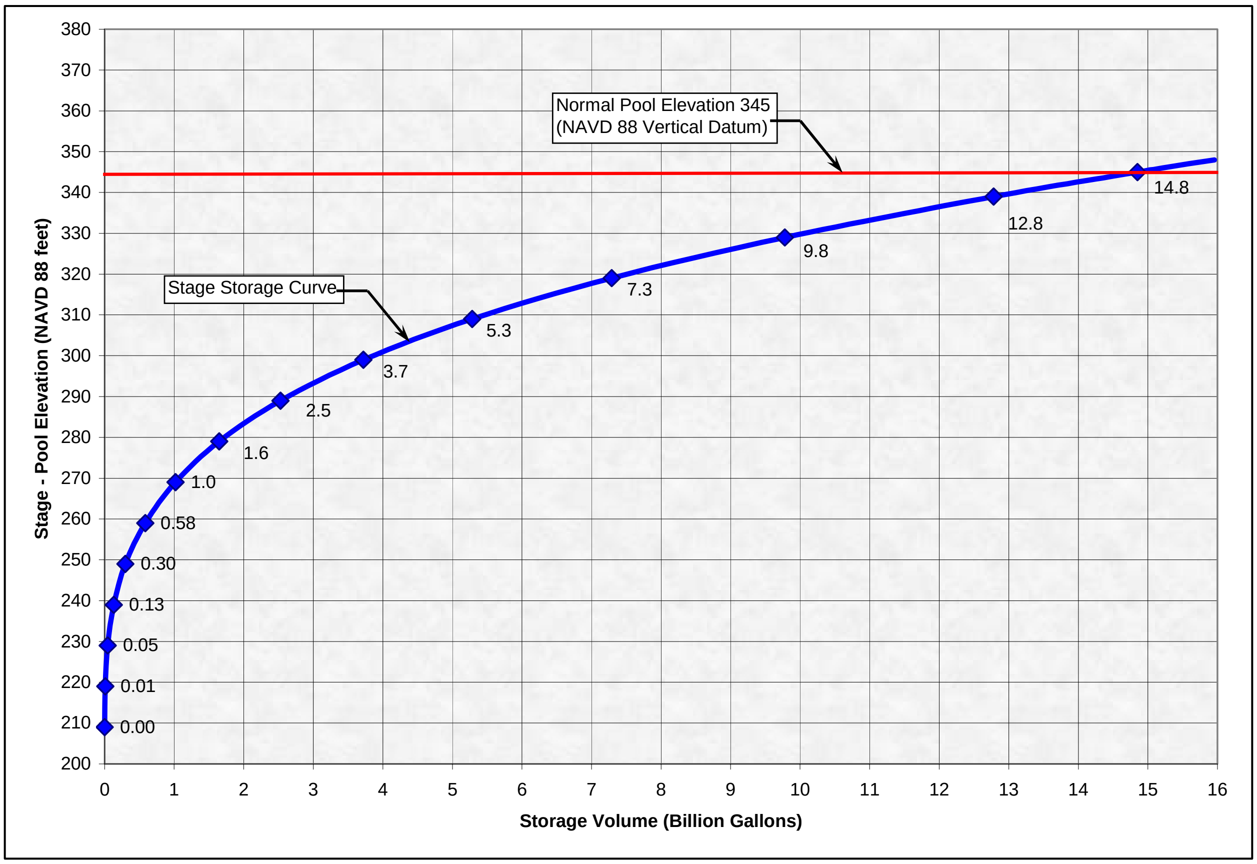
2.5 Dam Site Access

The primary access to the dam and pump station areas will be from Columbia Road (County Route 690) via an entry road. An all weather dam access road will cross both the Cobbs Creek Dam and the West Saddle Dam. A second road will provide access to the James River Pump Station and intake. These roads are all shown on Sketch 2.

2.6 Reservoir Pool

The 1,107-acre (1.73 square miles) reservoir will drain 1,825 acres (2.85 square miles) and store 14.8 BG of water at a normal pool elevation of 345 feet (NAVD 88). Assuming that 75 percent of the total reservoir volume will be considered the active storage pool, the usable volume will be 11.1 BG. This usable volume occurs in the top 45 feet of the reservoir's depth, between elevations 300 and 345. Figure 1 shows the Stage-Storage Curve for the reservoir.

Figure 1
Cobbs Creek Reservoir Stage-Storage Curve



2.7 Dam Spillways

The dam is expected to be classified as a Class III dam. A Class III dam is defined as a dam for which "failure would not likely lead to loss of life or significant economic loss". For a Class III dam at the Cobbs Creek location, the recommended spillway design flood is likely to be one-half the Probable Maximum Flood (half-PMF). The final determination of dam class and spillway design flood can only be made during detailed design of the project, and must be approved by the Virginia Department of Conservation and Recreation's Dam Safety Program as part of the dam construction permitting process.

To determine the preliminary maximum flood pool elevation of 347 (NAVD 88), a preliminary flood routing analysis was performed. The analysis showed that the half-PMF flood could be accommodated with a 2-foot rise in the reservoir water surface, to elevation 347 feet (NAVD 88) if an appropriately-sized service spillway is provided.

2.8 Reservoir Clearing

The reservoir pool area will be logged to an approximate elevation of 344 feet (NAVD 88). Logged areas in the main reservoir pool area will not generally be stripped or grubbed, with the exception of borrow areas for dam and roadway fill that may be developed within the pool area. These areas would be cleared and grubbed after logging. Disturbance in the bottom areas of Cobbs Creek will be minimized in order to reduce the transport of sediment to the dam site or downstream during the construction period. Erosion and sediment control measures will be implemented as required to prevent the downstream transport of sediment from cleared and logged areas, borrow areas, roadway construction, and the reservoir, dam and pump station sites.

An area for the disposal of excess soil and rock materials that are unsuitable for dam and roadway construction will be developed in the main reservoir pool area if a use for these materials can not be found off-site. All spoil will be placed and graded so that the top of spoil elevation does not exceed elevation 275 feet msl. This will assure that the area is not exposed when the reservoir water surface elevation is allowed to vary over the normal range of 300 to 347 feet (NAVD 88).

2.9 Utility Relocations

Two major utility easements cross the reservoir pool area. The easements run parallel to each other. One easement contains two parallel liquid petroleum distillate pipelines. The second easement contains an overhead power transmission line. It will be necessary to relocate these utility lines to an alignment outside the reservoir pool prior to completion of the reservoir. Relocation of the petroleum pipelines completely outside the watershed of the reservoir may be appropriate. Sketch 9 indicates the existing location of the pipelines and power line and a conceptual alternative alignment. The realignments of the petroleum pipelines and power transmission line will require extensive coordination with and the approval of both the Colonial Pipeline Company and Dominion Virginia Power. Colonial Pipeline Company has stated in a letter to the Cumberland County Attorney that based on the information available, relocation of their pipelines appears possible. A copy of this letter is included at the end of this section.

2.10 Impacts to Existing Structures

The only impacts to existing inhabited and actively utilized structures will be due to the filling of the reservoir to the normal pool level (Elevation 345, NAVD 88). One occupied house will be flooded by the reservoir pool. It is located on the eastern side of the reservoir pool and is accessed from Columbia Road (State Route 690).

Several homes and barns are located close to the edge of the reservoir pool, but have been confirmed by field surveying to be above the normal pool and maximum flood pool elevations of the reservoir. These homes and barns are along the eastern edge of the reservoir pool and are accessed from Columbia Road (State Route 690). There are other structures located within the pool area, but they are all uninhabited homes and barns in poor condition. Sketches 10, 11, and 12 show the locations of inhabited structures within or near the proposed reservoir pool area along the Route 690 corridor, including the one home that will be flooded.

3 WATER RELEASE SYSTEM

3.1 Reservoir Inlet/Outlet Structure

A multipurpose reservoir inlet/outlet structure is proposed to provide the following functions:

- Release of water from the reservoir to the James River for low flow augmentation.
- Release of water from the reservoir to Cobbs Creek to satisfy MIF requirements.
- Supply of water to the reservoir from the James River Pump Station.

The release of water back to the James River for low flow augmentation will be accomplished with a system of screens mounted to the exterior of the structure and control valves on the interior of the structure. The intake screens will be located at approximately elevations 330, 310 and 290 feet (NAVD 88). Each level will be sized for a downstream release of up to 50 mgd (77 cfs). Control valves will be placed at each level to control the flow and allow water from different levels in the reservoir to be withdrawn and mixed together before flowing down the Cobbs Creek Transfer Pipeline to the James River. The structure will allow water to be released at a 50 mgd rate down to a reservoir water surface of approximately 300 feet (NAVD 88). The release rate will decrease as the reservoir water surface drops below 300 feet and will cease when the water surface reaches 290 feet (NAVD 88). Emergency water releases below 290 feet (NAVD 88) will be possible through the reservoir drain.

A separate system of smaller screens and valves will be provided to control the release of water for MIF purposes to Cobbs Creek. This system will connect to a dedicated pipe that will discharge to Cobbs Creek at the base of the dam. Downstream releases will be measured below the dam. A minimum downstream release from the dam will be provided to equal the natural median monthly flow of Cobbs Creek at the dam site. The minimum release will be provided throughout the construction and filling of the reservoir. Calculation of the median monthly flow in Cobbs Creek at the dam site must be approved by the Virginia Department of Environmental Quality, in accordance with the VWPP.

Water pumped from the James River Pump Station will be routed through the Reservoir Inlet/Outlet Structure for release into the reservoir. When filling the reservoir the control valves will be opened so that water will flow from the inside of the structure out through the screens to the reservoir.

The structure will be a drop type tower structure constructed of cast-in-place concrete. The structure will be located on the upstream face of the dam. The intake will be connected to the top of the dam by a personnel bridge, to allow access for maintenance and operation of valves. The structure will be similar for either an RCC or Earth Fill dam.

3.2 Cobbs Creek Transfer Pipeline

The 84-inch diameter pipeline from the James River Pump Station to the Cobbs Creek Dam will carry water from the reservoir for low flow augmentation releases. The location of this pipeline is shown on Sketch 3. The releases will be made through either the Energy Dissipating Outfall Structure to Cobbs Creek or the Infiltration Bed Intake System directly to the James River. A metering system will be provided in the transfer pipeline so that the release flow rates can be measured and recorded.

3.3 Energy Dissipating Outfall Structure

The outfall will be located on the east side of the creek approximately 950 feet upstream of the creek's confluence with the James River. This location is southwest of the James River Pump Station and 2,500 feet downstream of the Cobbs Creek Main Dam. The outfall structure will be a standard U.S. Bureau of Reclamation impact type stilling basin, or a similar type of structure, designed for a maximum discharge flow of 75 mgd. This structure will have an overall footprint of approximately 20 by 25 feet. The structure will be recessed into the existing stream bank, which will be excavated to create a very short apron and discharge channel. This rip rap stabilized apron area and discharge channel will be approximately 50 feet long and will direct the discharge into the natural channel of Cobbs Creek.

At the maximum discharge flow of 75 mgd, water will flow out of the channel at an average velocity of 2 feet per second, with a depth of flow of 4 feet, assuming there are no backwater effects from the James River. The actual depth of flow will vary depending on downstream conditions in the creek and the James River

3.4 Infiltration Bed Release System

The Cobbs Creek Transfer Pipeline will allow water to flow from the Reservoir Inlet/Outlet Structure to the James River Pump Station. At the pump station, piping and valves will be provided to allow the flow to be routed to a single infiltration bed or, alternatively, the flow could be dispersed to several or all of the beds. Directing water back through an infiltration bed will initially flush sediments out of the bed and then provide a very low impact, non-erosive method of releasing water from the reservoir back to the river for low flow augmentation. The released water will reenter the river similar to a groundwater base flow and will be highly dispersed.

Colonial Pipeline Company

Gerald A. Beck
Project Leader – General Projects

410-569-6201 Direct
410-569-6509 Fax

September 10, 2004

VIA FACISIMILE AND EMAIL

Darvin E. Satterwhite, Esq.
Cumberland County, Virginia

Mr. Satterwhite:

In response to your letter dated September 9th, 2004, regarding the proposed reservoir project contiguous to the James River and Cobbs Creek in Cumberland County, Virginia, we offer the following comments.

While Colonial cannot conclusively state that there is not a "fatal flaw" with relocating the existing pipelines at your proposed site there doesn't appear to be a "fatal flaw" based on the information provided to date. It appears possible, though very expensive, to relocate the two petroleum pipelines within the subject parcel(s) or just outside of the parcel(s).

This high level assessment is based on the following assumptions.

1. An acceptable alternate route is located and obtained. We would need replacement easement in kind. Prior talks with your officers have indicated that you could utilize the powers of condemnation to acquire said easements for us.
2. All environmental permits can be obtained.
3. We would expect the project to be 100% reimbursable to Colonial Pipeline Company, for all costs, including but not limited to, engineering, permitting, materials, equipment, labor, surveying, inspection, etc.
4. We would expect a full set of engineering drawings from you of the proposed reservoir project. Said plans to be both plan and profile views.
5. Upon our receipt and review of your engineering drawings, we will submit an up-front preliminary engineering cost for your acceptance.
6. Upon our receipt of your check for the full amount of our anticipated preliminary engineering costs, we would determine if there was a fatal flaw, and if there is not, we would develop a relocation plan, which will include all expected costs associated with our construction activities. Said plan and cost proposal would be submitted to you for your acceptance.
7. A relocation of this magnitude cannot be accomplished readily. I would anticipate a minimum of one full year, from receipt of a check for the full amount of the estimated relocation costs (or some other payment agreement is reached), until we could initiate our construction relocation activities. It could take up to an additional year to relocate the pipelines.

Northeast District Office
2014 S. Tollgate Road, Suite 211 • Bel Air, MD 21015
Phone: 410-569-6200 Fax: 410-569-6509

Hopefully this brief response will answer most of your questions, and allow you to proceed with your presentation and decisions at your September 13th meeting. Colonial will continue to work with the county if it chooses to proceed with the development of its project.

Please feel free to contact me at the number listed above, or Buzz Lewandowski at 410-549-4128, if you have any other questions or concerns.

Sincerely,

Gerald Beck

C: Buzz Lewandowski